Rocky Flats Environmental Technology Site Actinide Migration Evaluation
Meetings April 30—May 2, 2001
Advisory Group
Greg Choppin, David Clark, David Janecky, Leonard Lane, A J Francis, Annie Kersting, Sumner Barr

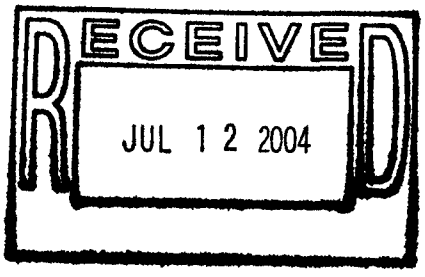
Summary and Recommendations for Path Forward

Several comprehensive modeling and data analyses efforts are being completed and documented These include water erosion/sediment transport/actinide mobility estimation procedures, air transport measurement and modeling, Site-wide water balance, Rocky Flats Alluvium groundwater flow and transport, and the Pathway Analysis Report The AME Advisory Committee feels that these comprehensive modeling and assessment efforts provide the basis for quantification of several integrated Site assessments required for closure and definition of stewardship activities For example, the relationships between soil action levels and surface water quality protection, Site configuration design and analysis, and post closure monitoring and stewardship activities all depend upon integration and application of these tools

In general, the AME Advisory Committee wants to know more about actinide analyses in several important areas The process and techniques used to sample, process and analyze waters collected from new and old groundwater wells in the 903 Pad area are of particular interest Similarly, air sampling data both on site and at the boundaries is of continued interest, to better understand transport pathway modeling and evaluation

Progress and Integration

This is a critical time to see integration between water balance, actinide migration (transport/erosion) and land configuration analyses and reporting Wind and water erosion modeling activities are making progress and we see more integration between these activities



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Results and Discussions

Air Transport Pathway – Martha Hyder

Objectives of the air transport modeling include assessment of impacts from soil remediation, D&D, and extreme events (e g high winds) on actinide transport in air Estimated actinide concentrations in air will be used for comprehensive risk assessments

An update of activities to estimate off-Site transport of wind eroded sediment and associated actinides was presented and results through the summer 2000 field season were summarized The dominant potential source of airborne actinides is the resuspension of contaminated soil particles in the lip area of the 903 Pad An area of several square kilometers of contaminated soil and vegetation resulted from remediation activities in the late 1960's Although the pad has been stabilized (for the time being) by paving with asphalt, substantial quantities of Pu and Am are distributed under the pad and to the east and southeast Transport calculations were based on a compilation of air-sampler measured data and on wind erosion model calculations

General direction of transport is east to east-southeast from the center of the Site because most winds occur from the northwest quadrant The Site maintains perimeter samplers and additional interior samplers in and near the Industrial Area (called the RAAMP network) Pu-239/240 has been measured for many years and Am-241, U-233/234, U-235, and U-238 since 1997 However, the AME Advisory Committee felt that the laboratories, their procedures, techniques, and QA/QC sample analysis information have not been presented for review and analysis The Committee feels that this information is critical and should be documented and presented in future reports and publications

Pu-239/240 background concentrations of airborne actinides due to resuspension of fallout deposition were estimated as 3 to 5 x 10^{-7} pCi/m^3 The Committee suggests that these calculations, their uncertainties, and the implications of subtracting "background concentrations" from total concentrations before off-Site transport calculations are made should be more fully documented Perhaps pie charts or bar charts illustrating the relative percentages of background and anthropogenic actinides sampled at each location, together with uncertainty measures, would be helpful Background estimates vary from 20% to nearly 90% of total measured Pu-239/240 flux at the Site boundary and thus are critical to accurate off-Site estimates and subsequent risk assessments

The Committee was very pleased to see the comparison of "measured" and "modeled" off-Site actinide flux computations Continued progress in improving the accuracy of the modeling, relative to the Site database, is essential as a path forward before the Air Transport section of the Pathway Analysis Report is finalized The Committee still feels that an order of magnitude difference (positive bias) between modeled and measured off-Site flux estimates may be too large This is a high priority to get resolved, largely because it implies phenomena that are not represented and therefore not understood

The Committee is encouraged to see efforts to characterize the stochastic renewal of wind-erodible source terms planned for FY2001 Characterizing the intra-seasonal depletion and renewal of these source terms may significantly improve the accuracy of the wind erosion modeling results It would be worthwhile to extend the evaluations to cover the potential impacts of climate changes that could change vegetation covers significantly Continued analysis and interpretation of wind erosion data from prescribed burns and wildfires are also important activities for FY-2001

Finally, the Committee is pleased to see continued progress and documentation of the Air Transport measurement and modeling results in the Pathway Analysis Report We suggest that prior to preparation of the next Draft, that the water erosion and wind erosion results and analyses be carefully compared to make sure that, where appropriate (i e climate files, vegetation cover characteristics, etc), common databases and periods-of-record are used to allow valid and consistent comparison of relative importance of air and water transport rates and amounts

Groundwater and Vertical Migration Pathways – Rob Smith

Rob Smith summarized results of groundwater data presented in three documents

- Actinide concentration data presented in Section 2 8 of the Pathways Analysis Report
- Analysis of Vertical Contaminant Migration Potential (RE/ER-96-0040 UN), and
- Groundwater Analysis Section of Pathway Report

Actinide concentration data in Section 2 8 of the draft Pathway Analysis Report summarizes data from two data sets The data sets are Background Geochemical Characterization Report and Draft Background Comparison for Radionuclides in Groundwater The AME was asked to evaluate this draft Section of the Pathway Analysis Report

The Vertical Actinide Migration in Groundwater Report presents a review of available bedrock geologic and hydrogeologic conditions at the Site This report focused on potential transport of DNAPL and organic solutes transport through Lower Hydro Stratigraphic Unit (LHSU) to Laramie-Fox Hills (L-F Hills) aquifer Actinides were considered but not evaluated in detail The major conclusions of this study were

- The 600 to 650 ft claystone unit in the LHSU that overlies the L-F Hills aquifer serves to effectively restrict vertical groundwater flow and contaminant movement

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- Vertical transport of contaminants is predicted to be very slow and therefore DNAPL and organic transport to the L-F Hills aquifer is not considered a threat
- The LHSU confining claystone have sufficient hydrologic and geochemical integrity to provide long-term protection of the regional aquifer

The groundwater analysis section of the Pathway Analysis Report presents data from groundwater samples collected from wells in the Rocky Flats Alluvium Groundwater has been analyzed for oxygen, tritium, Pu and U isotopes Six wells with samples from the unweathered bedrock (–(LHSU) had tritium values above background Pu 239/240 was also detected in several groundwater samples collected from the LHSU bedrock No tritium was detected in the groundwater samples that had levels of Pu above background There is some concern that these data may reflect contamination during sampling, and more effort to evaluate this hypothesis is underway Therefore, the conclusions from these analyses are incomplete and need further study

The AME was asked to evaluate the data, provide some interpretation and recommendations for further action, if necessary Now that new wells have been installed and data analysis is on going, it is important to evaluate new data in concert with the previous data presented in the Pathway Analysis Report It is critical to evaluate sampling protocols, analytical quality assurance, analytical methods, and detection limits in order to produce scientifically defensible interpretations

Surface Water Pathway and Status of Pathway Report on Actinide Sources – Ian Paton

The surface water pathway section of the DRAFT Pathway Analysis Report was described The general approach to defining source-terms, actinide loading, actinide monitoring, and surface water modeling was described For each of the actinides of interest, data are presented from Water Years 1997 through 1999 The actinide load at a particular surface water monitoring station is a function of both the actinide concentration in the water and the volume of water (yield) at the station The analysis of measured and modeled Site surface water data indicate actinide transport patterns that generally support the transport mechanisms addressed in the conceptual model In general, this section seems well organized, and the Advisory Group was asked to review this section in detail, and return comments

The section of the Pathway report on actinide sources was described A general presentation was given on the measured actinide data from the environment at RFETS For each media, measured data were presented for Pu-239/240, Am-241, U-233/234, U-235, and U-238 The media include surface soil, subsurface soil, sediments, building materials, surface water, groundwater, air, and biota The methods used to determine background, and how these

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backgrounds were subtracted from the data were discussed The Advisory Group was asked to review this section in detail, and return comments

Uranium Usage and Potential Contamination in Buildings – Laurie Gregory-Frost

A compilation of historical uranium usage, its transfer between buildings, and potential contamination in buildings was presented This is a truly impressive compilation, and will be critically important to focus future discussions about uranium contamination, transport, and integration with D&D and ER activities A general map was prepared that shows all the buildings and areas where there is either known or potential uranium contamination It would be useful to prepare a new map that shows the overlay of these potential contamination sites, with the results of kriging analysis of known uranium contamination for comparison

A subsequent discussion took place on uranium and its impact on surface water quality It was stated that sampling has not revealed the movement of uranium from sources such as the ash pits In reality, the AME group has not had detailed discussion of the chemical form of uranium in sources such as the ash pits, and it is recommended that this be the topic of discussion in the July meeting In particular, we should discuss the differences that can be expected from uranium in the form of oxides [either U(VI) or U(IV)] or more soluble forms, and what we have learned from study of natural uranium deposits such as Oklo We should also discuss the possibility that D&D activities will alter the hydrology at the Site, and what possible impacts that could have on hydrologic containment of soluble forms of uranium

Microbiological Processes, Macro-Biological Transport Pathway, and Reactive Barriers – Larry Hersman, Ian Paton, Annette Primrose

Microbiological processes influencing the mobility and stability of actinides and the mode of transfer of Pu through the food chain from soil to mammals were summarized by Larry Hersman and Ian Paton, respectively Hersman described the microbiological processes that are relevant to RFETS and summarized them in a figure with several arrows going back and forth Although the key processes are covered in the figure, it is rather confusing and it may be a good idea to modify it so that it is easy to follow Hersman summarized in some detail what was covered in the rest of the Pathway Report The microbiological section of the report will be reviewed and specific comments will be provided in June Microbiological research at RFETS should identify one or two major problems and should focus on them For example the stabilization of colloids in the pond by enhanced microbial action is an area worth pursuing In addition, comparative information from the published literature on biologic processes in similar environments would be very useful (e g Pawnee National Grass Lands)

There are no real surprises with the mode and extent of Pu transferred from soil to plants to animals One area worth mentioning is that there is no detectable root uptake of Pu from soil by plants This would suggest the dissolution and uptake soluble Pu is negligible, consistent with the findings that Pu is quite insoluble in the soil

Annette Primrose gave an overview of the treatment of volatile organic solvents and uranium and nitrate plume using reactive barrier technology Removal of uranium and nitrate from groundwater by reactive barrier technology is effective provided all the conditions such as water flow are met We would like to receive copies of the recent reports The potential application of this technology among other options for long-term stewardship should be considered

D&D Activities and Actinide Speciation Characterization – Tom Scott, Jeff Stevens, Doug Bryant

The present status and preliminary results of ongoing syncrotron experiments to determine Pu speciation in concrete and soils was discussed It was concluded that we need to review the current understanding of actinides within and interacting with concrete The AME group also feels that it is important to investigate some limited leaching and laboratory interaction experiments to support characterization results and interpretation We learned that the next syncrotron experimental run will be in May, and look forward to an update on results at the July meeting

Discussion of K_ds

There was a general discussion between members of the AME advisory group, DOE, and Kaiser-Hill senior managers regarding the use of K_d values for risk assessment at RFETS The use of K_d values to assess the migration and hence the risk of exposure to uranium at RFETS is justified based on our understanding of the geochemical behavior of *uranium* at RFETS Therefore, models such as RESRAD are defensible for uranium risk assessment However, based upon our current scientific understanding of plutonium behavior at RFETS, use of a K_d is of little value for plutonium, since the assumption of a molecular-sized soluble species of Pu is scientifically incorrect at RFETS Since physical (particulate) transport is the dominant Pu migration pathway at RFETS, it is the expert judgement of the AME Advisory Group that the use of K_d values to assess migration and hence risk of exposure to *plutonium* at RFETS is not scientifically acceptable and not defensible legally

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Documents Provided to Advisory Group

Viewgraphs – Macro-Biological Actinide Transport Pathway [Ian Paton]
Status of Actinide Migration Evaluation Projects – April 2001 summary table [Christine Dayton]
Viewgraphs – Microbial Transformations of Actinides [A J Francis]
Report on ICPMS analysis of Pu isotopics – Michael Ketterer/NAU, with letters and response from Jeb Love
Viewgraphs – Microbial Characterization at RFETS Effects on Actinide Transport [Larry Hersman]
Draft Pathway Analysis Report – Sections 1-7 and Appendices A,B
Draft Actinide Migration Evaluation Pathway Analysis Report – Summary Report
Hulse, S E , Ibrahim, S A , Whicker, F W , and Chapman, P L (1999) Comparison of ^{241}Am, ^{239,240}Pu and ^{137}Cs concentrations in soil around Rocky Flats Health Physics 76(3), 275-287
Pan, V , and Stevenson, K A (1996) Temporal variation analysis of plutonium baseline concentration in surface air from selected sites in the continental US J Environ Radioactivity 32(1) 239-257
Viewgraphs – Uranium usage and potential contamination in buildings at Rocky Flats Environmental Technology Site [L Gregory-Frost]
Viewgraphs – Groundwater actinide pathway [Robert G Smith]
White Paper – Analysis of vertical contaminant migration potential (August 16, 1996), RF/ER-96-0040 UN
Viewgraphs – Air transport pathway Update and pathway analysis report [Martha Hyder]
Summary of valence state of Pu on concrete – sample and analysis operations listing
Bronikowski, M and Choppin, G R (1998) Pu in INEL Aquifer Unpublished report to INEL
Jorgensen, Doug to Navratil, James (May 24, 1996) Evaluation of Plutonium Data Unpublished INEL report, with review by Greg Choppin
Newman et al (9/1995) INEL-95/282 and ER-WAG7-82

Documents and Information Requested for Advisory Group

Documents and reports on operations of reactive, permeable barriers
Procedures and reports on field sampling approaches for aseptic wells
Procedures and reports on actinide analytical techniques and results (including QA/QC) for aseptic wells
Recent reports on the treatment of volatile organic solvents and uranium and nitrate plume using reactive barrier technology

Requests for Future Presentations and Information

Report on operations of permeable barriers

Land configuration progress and perspective (early rather than later)

Participants in AMS technical meetings

Name	Organization
Greg Choppin	FSU
David Clark	LANL
David Janecky	LANL
Leonard Lane	USDA, Tucson
A J Francis	BNL
Annie Kersting	LLNL
Chris Dayton	K-H
Bob Nininger	K-H
Greg Wetherbee	WWE
Russell McCallister	DOE/RFFO
Martha Hyder	Radian
Sumner Barr	LANL
Elizabeth Pottorf	CDPHE
Ken Niswonger	CDPHE (U isotopics)
Steve Singer	RMRS (U isotopics)
Ian Paton	WWE
Larry Hersman	LANL
Rob Smith	K-H
Laurie Gregory-Frost	E2
John Rampe	DOE/RFFO
John Stover	DOE/RFFO
David Shelton	K-H
Alan Parker	K-H
Lane Butler	K-H
Tom Scott	K-H
Jeff Stevens	K-H
Doug Bryant	K-H

Future Meetings

July 23-25 – 2001 fourth quarter site meeting
October 15-17 – 2002 first quarter site meeting
January 7-9 – 2002 second quarter site meeting

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